

Grade 9 Science – Unit 2 Electricity

What is Static Electricity?

As you know, everything is made of matter. Matter is composed of atoms which contain positive protons, neutral neutrons and negative electrons. The protons and neutrons reside in the nucleus of the atom while the electrons are located in orbits surrounding the nucleus. The charge of one proton is equal in strength to the charge of one electron. When the number of protons in an atom equals the number of electrons, the atom itself has no overall charge. That is, the atom is neutral. The electrons move and they can move from one atom to another. If the atom loses electrons, it becomes a positive ion. If the atom gains electrons, it becomes a negative ion.

Static electricity is the imbalance of positive and negative charges.

How can we move electrons from one place to another?

One very common way is to rub two objects together. If they are made of different materials, and are both insulators, electrons may be transferred (or moved) from one to the other. The more rubbing, the more electrons move, and the larger the static charge that builds up.

What causes static electricity?

Static electricity is usually caused when certain materials are rubbed against each other—like wool on plastic or the soles of your shoes on the carpet. It is also caused when materials are pressed against each other and pulled apart.

The process causes electrons to be pulled from the surface of one material and relocated on the surface of the other material. It is called the triboelectric effect or triboelectric charging.

Rubbing certain materials together can cause the build up of electrical charges on the surfaces. Opposite charges attract and same charges repel. Either charge will be attracted to something of neutral charge. Sparks are an extreme case of electrons being attracted to an object that has a positive charge and jumping across an air gap, thus heating the air for a fraction of a second.

If a material is more apt to give up electrons when in contact with another material, it is more positive. If a material is more apt to "capture" electrons when in contact with another material, it is more negative.

Item	+ or -		Item	+ or -
Human hands	+		Steel	Neutral
Glass	+		Copper	-
Human hair	+		Nickel	-
Nylon	+		Brass	-
Wool	+		Styrofoam	-
Fur	+		Saran Wrap	-
Silk	+		Teflon	-

What happens if I rub two positive items together (e.g., glass rubbed by silk)?

Glass rubbed by silk causes a charge separation because they are both positives. The same applies for wool and fur. The table is arranged in order of RELATIVE positive and negative (e.g., glass is MORE positive than human hair; saran wrap is MORE negative than copper). Thus, the farther the separation in the table, the greater the effect.

- ? Describe this in your own words.
- ? If Human Hands are the MOST positive, why do we not have sparks flying from our skin on contact with other materials? (Too moist...see below)

When materials come into contact with each other, a chemical bond called ADHESION may be formed between the two materials. Depending on the triboelectric properties of the materials, one material may "capture" some of the electrons from the other material. If the two materials are now separated from each other, a **CHARGE IMBALANCE** will occur. The material that captured the electron is now negatively charged and the material that lost an electron is now positively charged. This charge imbalance is where "static electricity" comes from. The term "static" in this case is deceptive, because it implies "no motion," when in reality it is very common and necessary for charge imbalances to flow. The spark you feel when you touch a door knob is an example of such flow.

Why is there more static electricity in dry air?

Static electricity is formed much better when the air is dry or the humidity is low. When the air is humid, water molecules can collect on the surface of various materials. This can prevent the build up of electrical charges. How? The moisture coats the surface of the material, providing a low-resistance path for electron flow. This path allows the charges to "recombine" and thus neutralize the charge imbalance.

- ? Using this logic, why do clothes in a dryer stick together? Clothes in the dryer build up an electrostatic charge. The dryer provides a low-moisture environment that rotates, allowing the clothes to continually contact and separate from each other. The charge can easily be high enough to cause the material to attract and "stick" to oppositely charged surfaces